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Plastics

New grades contribute to expanding market

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JUNE 3, 1985

News of the Week

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Cover: Union Carbide/Shell joint-venture polypropylene plant in Seadrift, Tex.

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Business

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Government

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Great Plains Coal Gasification plant will shut down shortly if the government fails to give it additional funds. **Page 19**

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Product Report

Increased development work is expanding plastics' use in existing markets, opening up new applications. **Page 23**

Physicists promote new accelerator

High-energy particle physicists are trying to sell other scientists, politicians, and the public on their latest dream machine. It's called the superconducting supercollider (SSC). If the machine is built, upon completion in the mid-1990s it will cost about $4 billion in 1985 dollars.

Even particle physicists, who are well acquainted with big-budget projects, realize that a $4 billion price tag sounds steep in an era of tight budgets. At last week's annual meeting of the American Association for the Advancement of Science in Los Angeles, those physicists convened a symposium to push the necessity of SSC as "a new window on the universe."

The proposed accelerator would be a synchrotron with a circumference of 90 to 160 km. It would accelerate two beams of protons in opposite directions to energies of 20 trillion electron volts (TeV). By contrast, the Tevatron at Fermi National Accelerator Laboratory, now the most powerful U.S. synchrotron, has a 6-km circumference and attains beam energies approaching 1 TeV.

SSC gets its moniker from use of electromagnets based on superconducting materials to guide the beams of protons around the circular track of the synchroton. According to physicists involved in the project, the suitability of superconductivity for synchrotons has been demonstrated in successful operation of the Tevatron.

At a AAAS press conference, Fermilab physicist Leon M. Lederman argued that SSC "is not just another accelerator." SSC is driven by a set of related "scientific crises," he says, which center on the fundamental nature of mass. The energy range set for SSC is not an arbitrary step to higher energies, but has been determined on the basis of theoretical calculations showing that 40-TeV collisions will approach conditions that existed in the first instants after the Big Bang, he says. As such, studies of such collisions would provide experimental data on open questions in current grand unification theories.

Lederman puts forth a familiar, heady line of reasoning to justify SSC's expense. The device, he says, is yet another "critical" stage in physicists' efforts to define a "complete world view," an effort that dates back intellectually 2500 years. During that time, he says, a clear thread links the evolution of particle physics and the various scientific revolutions that have changed humans' view of the universe and created modern civilization.

Lederman stresses, however, that SSC isn't likely to be the final step in physicists' quest for ever more powerful accelerators. The history of particle physics shows that each new energy domain that has been achieved has opened up a new set of questions, he says.

Preliminary design work for SSC already is being done at Lawrence Berkeley Laboratory. R&D for the project is under way at several national labs, universities, and industrial firms. And, as has happened with several recent big-budget scientific projects, many states, including California, Texas, Illinois, and North Carolina, are scrambling to be selected as the SSC site. □

Costs of industrial waste management to rise

A Congressional Budget Office analysis of the costs of handling hazardous waste and cleanup of waste disposal sites finds that by 1990 industry could be paying nearly twice as much for handling wastes as it paid in 1983.

Prepared at the request of the Senate Committee on Environment & Public Works, the study analyzes these costs and several proposed ways of collecting money for Superfund, as well as technologies available for reducing the volume of hazardous wastes. CBO examined the effect of 1984 changes in the Resource Conservation & Recovery Act and of an expanded Superfund program on what various industries will have to pay to dispose of hazardous wastes.

CBO estimates private industry spent a maximum of $5.8 billion for disposal and treatment of hazardous wastes in 1983, and state and federal governments spent about $700 million. Changes in the law, including lowering the exemption for low volumes of waste from 1 metric ton per month to 0.1 metric ton per month, and a larger Superfund, could raise that total for industry to $11.2 billion by 1990, an increase of nearly 94%, according to CBO. The chemical industry would be expected to pay $3.1 billion, or 28% of that total.

In evaluating the various options for waste control and for raising revenues for Superfund, CBO makes no recommendations, although it gives more weight to some ideas

Cost of complying with waste disposal law could double by 1990 unless waste volume is cut

$ Millions	1983	1990	
		No waste reduction	Waste reduction
Chemicals and allied products	$1544	$ 3,122	$2283
Primary metals	1243	2,302	1661
Fabricated metal products	899	1,191	735
Rubber and plastic products	796	2,026	1771
Miscellaneous manufacturing	267	356	308
Nonelectrical machinery	254	324	279
Motor freight transportation	229	247	247
Transportation equipment	191	360	286
Electrical and electronic machinery	156	237	163
Petroleum and coal products	136	940	634
Wood preserving	58	91	61
Drum reuse/cleaners	6	6	2
TOTAL	$5779	$11,201	$8429

Source: Congressional Budget Office

than others. Waste reduction by industry is the most practical way to save, CBO indicates. Without waste reduction, some industries, such as the wood preservative industry, will have waste control costs that exceed their projected profits in the next five years. Effective waste reduction could halve the increase in waste control costs. It also would reduce the need for landfills.

One thing the government might do to help is to fund more R&D on advanced waste and hazard reduction measures. EPA is not now supporting such research. Better enforcement efforts, including more inspections, would encourage compliance with the laws. And some sort of refund or deposit system might be set up to encourage recycling of some wastes, such as solvents and waste oils.

The best revenue bet is a waste-end tax, CBO says. "Waste-end taxes would go far to encourage lower hazardous waste production and to support waste management shifts intended by the 1984 RCRA amendments," the report concludes. The broader tax base of the waste-end tax is seen as a big advantage over reliance on feedstock taxes (Superfund's method). Other analysts have said waste-end taxes are impossible to administer, but CBO appears to believe their benefits overshadow this problem. The report does acknowledge that as wastes diminish, so will revenues from this tax. The shortfall then might have to be made up by corporate receipt taxes or general tax revenues. □

Tax reform would renew R&D tax credit

In President Reagan's speech to the U.S. public last Tuesday night, he mentioned the need "to strengthen growth by preserving incentives for investment, research, and development." And among all the business tax incentives that are repealed or curtailed in the most recent Administration tax plan, the credit for R&D expenditures, which expires this year, is somewhat exceptional in that it would be renewed at least until Dec. 31, 1988.

However, as detailed in the Treasury Department's 460-page explanation of the tax proposal, the definition of qualifying research would be tightened. The department notes that some taxpayers take the view that the costs of any trial-and-error procedure are eligible for the current R&D credit, even though there may be little doubt about the outcome of the procedure. Under its new proposal, research would qualify for the credit only if it relates to a process of experimentation encompassing the evaluation of alternatives that involve a serious degree of uncertainty about whether the desired results can be achieved.

The Administration's proposal does not directly address the question of allowing a credit for industry contributions to fund basic university research or an enhanced charitable deduction for contributions of scientific equipment to universities. Treasury says, however, that contributions "would be considered in the context of legislative efforts to extend the research credit."

But if the scientists who do the research happen to win monetary awards for their work—such as the American Chemical Society's Cope Award or even a Nobel Prize—they would have to pay taxes on such awards. Under current law, prizes or awards made primarily in recognition of scientific achievement are not taxable. The Administration's new tax plan would repeal that provision of the tax law as well as the currrent exclusion allowed for scholarships and fellowships. Under the new plan, degree candidates would have to include scholarships and fellowships in their gross income, unless they were required to be, and were, spent on tuition or equipment needed for courses.

It's still uncertain whether these provisions will be included in the final tax bill that emerges from Congress, if one does. The opposition forces are already gathering. Groups as diverse as the American Petroleum Institute, the International Chemical Workers Union, and the Solar Energy Industries Association are registering their opposition to various portions of the Administration's tax proposal. □

Dow will acquire membranes producer

Going outside the company to expand its young membranes business, Dow Chemical has signed a definitive agreement to buy FilmTec Corp., a Minneapolis-based manufacturer of reverse-osmosis membranes, for about $75 million.

After the merger, FilmTec, which owns three facilities in the U.S. and one in the U.K., will become a wholly owned subsidiary of Dow and will operate as a freestanding organization within Dow's membrane products department. In the 12 months ending March 31, 1985, FilmTec, whose products are used in water purification and other separation applications, reported net income of $1.4 million on sales of $11.1 million.

The acquisition will broaden the range of Dow's membrane products department, which came into being last September in the combination of Dow's Midland-based hollow fiber membrane venture and Cynara Co., a Houston provider of gas separation services to the oil and gas industry. Cynara is a 90%-owned subsidiary of Dow. Since then, the department has had one major new product introduction: Generon air-separation systems for low oxygen-content nitrogen used in the chemical, metal producing, metalworking, and food processing industries (C&EN, March 4, page 26).

Once the merger with FilmTec is completed, Dow intends to transfer some of its reverse osmosis membrane commercial activities to FilmTec. Few changes are expected in FilmTec's staff.

Dow will pay FilmTec shareholders $21.75 in cash for each of the 3.45 million shares outstanding. The merger agreement, which has been approved by the boards of directors of both companies, must still be agreed to by FilmTec shareholders, but Dow already has arranged for the guaranteed right to vote and purchase an aggregate of 30.4% of FilmTec's common stock now held by eight owners. In addition, Dow has an option to buy up to 1.6 million newly issued shares for $21.75 each. □

Drug Firm Profitability Increased in First Quarter

Cost controls and adjustments to competition in hospital supply market give profit margins boost despite small increase in sales revenues

David Webber, C&EN New York

The strength of the dollar against foreign currencies continues to shave revenue gains for the pharmaceutical industry. Although this factor has not been enough to halt growth, it has slowed it considerably. For the second quarter in a row, consolidated sales of a group of 18 major drug companies increased in first-quarter 1985 only 3% over the year-earlier period. The rate of growth has been declining steadily since fourth-quarter 1983, when sales rose 8% over those of fourth-quarter 1982.

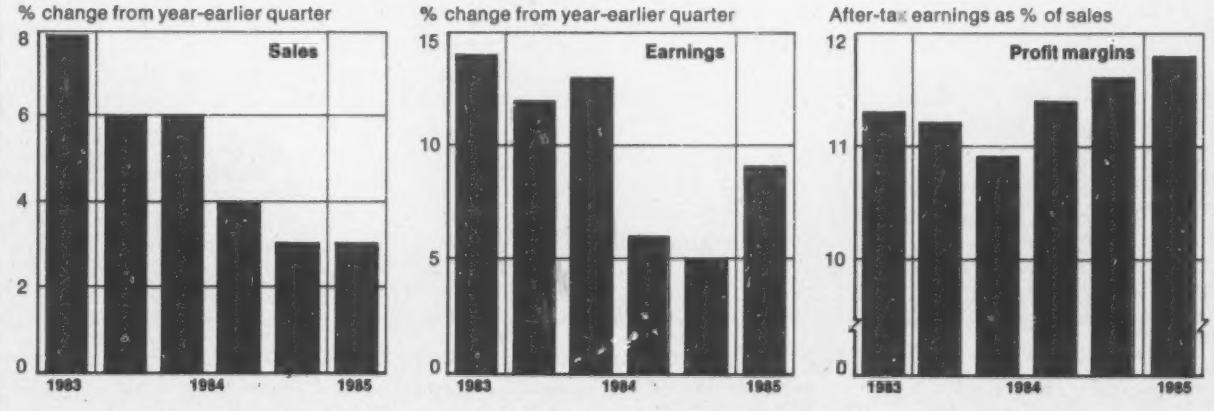
However, by pruning expenses and adjusting their product lines to deal with new competitive pressures in the hospital supply market, drug firms nevertheless have succeeded in raising profitability for the third straight quarter. At 11.8%, the consolidated profit margin (after-tax income as a per cent of sales) of the group of 18 companies was well above the first-quarter 1984 level of 11.2% and the postrecession low of 10.9% in the second quarter of last year.

Although growth in net income for the group, at 9%, was below the year-earlier level of 12%, almost all of the 18 companies managed to boost earnings in the first quarter. Only Avon Products, with a 23% decline, and Upjohn, which had a 21% decline in earnings, reported lower net income. By contrast, five of the 18 firms showed declines or no growth in sales during the quarter.

As has become common, earnings statements bemoaned the impact of the dollar's strength. Becton, Dickinson, for example, which reported a meager 1% increase in sales, notes that if exchange rates had remained unchanged from their first-quarter 1984 levels, revenues would have increased more than 4%, or $8 million, and that earnings would have been $800,000 higher. In local currencies, the company says, sales outside the U.S. rose 14%, but currency translation cut that to 3% growth to $71.7 million, or 25% of total sales. Sales in the U.S., at $216 million,

Horan: dollar's strength hurt results

Pharmaceutical industry 1985 first-quarter results



Note: All sales, earnings, and profit-margin statistics are based on combined results of the 18 companies listed on page 13.

were unchanged from the year-earlier quarter.

Similarly, Bristol-Myers, which reported an overall 3% sales gain, saw 5% growth in domestic sales offset by a decline in international sales because of the adverse effect of exchange rates, says Richard L. Gelb, chairman of the company. In local currencies, overseas sales increased, he says. Exchange rate fluctuations cut total company sales growth about 4%, or $41 million, in first-quarter 1985.

Other companies give similar reports. "First-quarter results were adversely impacted by the continued strength of the U.S. dollar," says John J. Horan, chairman and chief executive officer of Merck & Co. "If the effects of currency exchange were excluded, sales would show an increase of 8%." Likewise, Edmund T. Pratt Jr., chairman and chief executive officer of Pfizer, points out that strong performance by the domestic health care business was offset by a decline in overseas results due to the strong dollar. And Robert P. Luciano, chairman, president, and chief executive officer of Schering-Plough, which reported no increase in sales in the first quarter, says revenues would have climbed 8% were it not for currency exchange factors.

Performance by the drug companies' chemical business segments was mixed. Eli Lilly, for instance, whose increase in pharmaceutical sales was the chief bright spot in a 2% rise in overall revenues, says the primary drag on sales dollars was the agricultural chemicals business. Lower selling prices for the firm's Treflan herbicide brought the total down, overwhelming what the company describes as excellent sales growth by Sonalan herbicide, now in its second marketing year. Sales of animal health products also declined in the first quarter.

For Avon, on the other hand, whose primary business of beauty products did poorly, the Mallinckrodt division reported a 7% increase in sales. And Upjohn, which suffered through a 3% decline in overall sales, says its chemical segment's sales climbed 10% in the first quarter, mostly because of increased worldwide polymer sales and improved polyurethane foam sales. Still, because of high costs in foreign markets and the strength of the dollar, Upjohn's chemical segment recorded an operating loss.

Merck chairman Horan says that company's specialty chemical and environmental products sales declined from their year-earlier levels because of competition and currency fluctuations. For Pfizer, the dollar's strength and "less robust market conditions" led to flat sales in specialty chemicals and sales declines of 2% in agriculture and 5% in materials science, the company says. And Sterling Drug's first-quarter sales in the chemicals and other products business segment, at $34 million, were down 7% from a year earlier.

Some companies blame part of the mediocrity of their performance for the quarter on the costs of restructuring and similar programs that, although crimping results now, will yield higher earnings in the future. Avon, for instance, notes that its beauty products operation, which had a 14% decline in sales, completed a restructuring effort in the first quarter. Also, Upjohn points out that changes made in marketing strategy for its agricultural business was the primary cause for a 7% decline in sales for the segment. The company says that the change in its seed marketing approach deferred revenues until the second quarter. In addition, Upjohn divested its plant health business in the first quarter, further lowering revenues.

G. D. Searle, having hitched its wagon for now to its star NutraSweet brand aspartame sweetener, continued its robust growth. Sales rose 20% and net income 38% in the first quarter, with $176 million, or 52% of all sales, coming from aspartame. At the same time, aspartame margins declined, the result of price adjustments ceded to soft drink manufacturers to hasten their shift to the 100% aspartame sweetener content in diet drinks that now prevails over the earlier aspartame-saccharin mix.

In addition, Searle, which is striving to pump up its aging pharmaceutical product line, spent 16% more on R&D in the first quarter than a year earlier. Also, earnings were reduced by expenses related to the company's exploration of possible methods by which the holdings of the Searle family might be diversified. That episode, which included talks with several other companies interested in buying either the entire corporation or parts of it, ended in late March, when Searle decided to continue as an intact, independent operation. □

Drug earnings rose 9% in the first quarter

	Sales ($ millions)	Earnings[a] ($ millions)	Change from 1984 Sales	Change from 1984 Earnings	Profit margin[b] 1985	Profit margin[b] 1984
Abbott Laboratories	$ 756.2	$102.2	5%	17%	13.5%	12.2%
American Home Products	1207.5	180.9	6	10	15.0	14.5
Avon Products	669.4	23.1	−8	−23	3.5	4.1
Baxter Travenol	486.0	39.7	21	12	8.2	8.8
Becton, Dickinson	287.4	22.0	1	62	7.7	4.8
Bristol-Myers	1082.5	124.6	3	13	11.5	10.4
Lilly	908.8	160.9	2	10	17.7	16.4
Merck	856.3	131.5	1	5	15.4	14.7
Pfizer	945.7	147.3	3	15	15.6	13.9
Revlon	551.2	28.1	−2	15	5.1	4.3
A. H. Robins	166.4	21.5	6	35	12.9	10.2
Schering-Plough	487.0	54.1	0	2	11.1	11.0
G. D. Searle	337.1	34.9	20	38	10.4	9.0
SmithKline Beckman	770.0	131.8	7	1	17.1	18.2
Squibb	453.1	42.3	6	15	9.3	8.6
Sterling Drug	415.7	31.9	−6	3	7.7	7.0
Upjohn	545.5	51.6	−3	−21	9.5	11.5
Warner-Lambert	794.6	59.9	2	10	7.5	7.0

a Excludes significant extraordinary and nonrecurring items. b After-tax earnings as a percentage of sales.

U.S. petrochemical outlook not so dismal

Despite the new low-cost competition from Saudi Arabia and other energy-rich nations, the future of the U.S. petrochemical industry is not so bleak as some forecasters have painted it.

The three traditional petrochemical-producing areas—the U.S., Japan, and Western Europe—are about set to absorb the exports of ethylene derivatives from the first round of plant building in the new petrochemical-producing areas such as Saudi Arabia and Canada. A second round of expansion is not yet in sight for the new areas. That means that the traditional producing areas, including the U.S., can look forward to resuming good growth in the late 1980s.

That, at least, is how Richard D. Dodge sees the U.S. petrochemical outlook. Dodge, vice president of DeWitt & Co., Houston, told a recent meeting of the Chemical Marketing Research Association in New York City that sometime in the early 1990s, U.S. ethylene producers will have to start thinking about new capacity. Exactly when depends upon the timing and volume of imports from the new producers of ethylene and its derivatives. Meanwhile, as world ethylene output leans more toward light feedstocks, propylene will become tight in the U.S. and throughout the world. The U.S., Dodge says, probably will become the major propylene supplier to the rest of the world.

Dodge acknowledges that a major shift in international ethylene supply, if not demand, is under way. Countries with low-cost energy resources are converting those resources to ethylene and its derivatives. With little demand at home, the logical alternative for those countries is the export market. The best-known example is Saudi Arabia, but it is also true of Canada, Singapore, and, to a lesser extent, several other countries.

U.S. producers can't match the production costs of these newcomers. Dodge estimates that it costs, on average, $420 to make a metric ton of ethylene in the U.S. In Canada, the comparable cost is only $340, and in Saudi Arabia a meager $210 (10 cents per lb).

Dodge says that in the four-year period 1984-87 the traditional producing areas will have to absorb 3 million to 3.5 million metric tons (ethylene equivalent) of product from the new producers. Half of that will move into the U.S. Japan and Western Europe will split the remainder almost evenly.

However, by 1988, the U.S. market will absorb the impact of these imports and growth can resume once more, Dodge says. New capacity could be needed in the U.S. by 1990 or 1991, although imports could push the date ahead to 1992 or 1993. The alternative, he says, could be even more imports of ethylene derivatives, if an economic supply is available from somewhere in the world. Whether there will be more capacity or more imports for the U.S. is the subject of a heated debate, Dodge says.

Right now, no plans have been announced for a second round of new ethylene complexes. But that very well could change by the early 1990s, Dodge says, primarily in southern and eastern Asia. Several countries in the area have the necessary resources, which they have tried to convert into petrochemicals over the past few years. In the next decade, they may finish the job and eliminate the need for imports of some ethylene derivatives.

Dodge doesn't believe that the potential Asian producers will become major exporters, like Saudi Arabia and Canada. Instead, they will use their production to reduce imports, develop their own economies, and convert their petrochemicals into downstream products using low-cost labor. It is those finished goods that will be exported, he explains. Dodge also expects other developing countries to try satisfying their own internal demand and to provide some additional product for export, such as Brazil now does.

The world ethylene feedstock picture will change, too. Dodge expects a definite shift to take place to ethane-based feedstock. About 22% of the world's ethylene was produced from ethane last year. By 1994, that share will increase to 30%. That means that the shortfall of coproducts from ethylene plants, particularly propylene, will have to come from other sources.

In the U.S., ethylene production will shift from light feedstocks to heavier feeds, such as naphtha and gas oil. And that could help U.S. producers meet the expected propylene shortage throughout the world.

Historically, most propylene has come from refineries, primarily from catalytic crackers. The U.S. has more catalytic cracking capacity by far than any other country. Thus, says Dodge, as world propylene supplies decline, the U.S. will become the most likely source of new supplies. He sees opportunities for propylene derivatives plants on the West Coast because demand for exports to the Far East will be great.

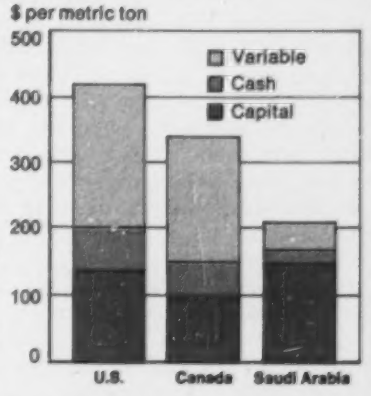
Earl Anderson, New York

World will shift to lighter feedstock

Feedstock	World ethylene production, % 1984	1989	1994
Ethane	22%	27%	30%
LPG	15	14	11
Naphtha	54	48	46
Gas oil	8	10	12
Other	1	1	1
TOTAL	100%	100%	100%
Production (billion of lb)	84.2	100.4	114.5

Source: DeWitt & Co.

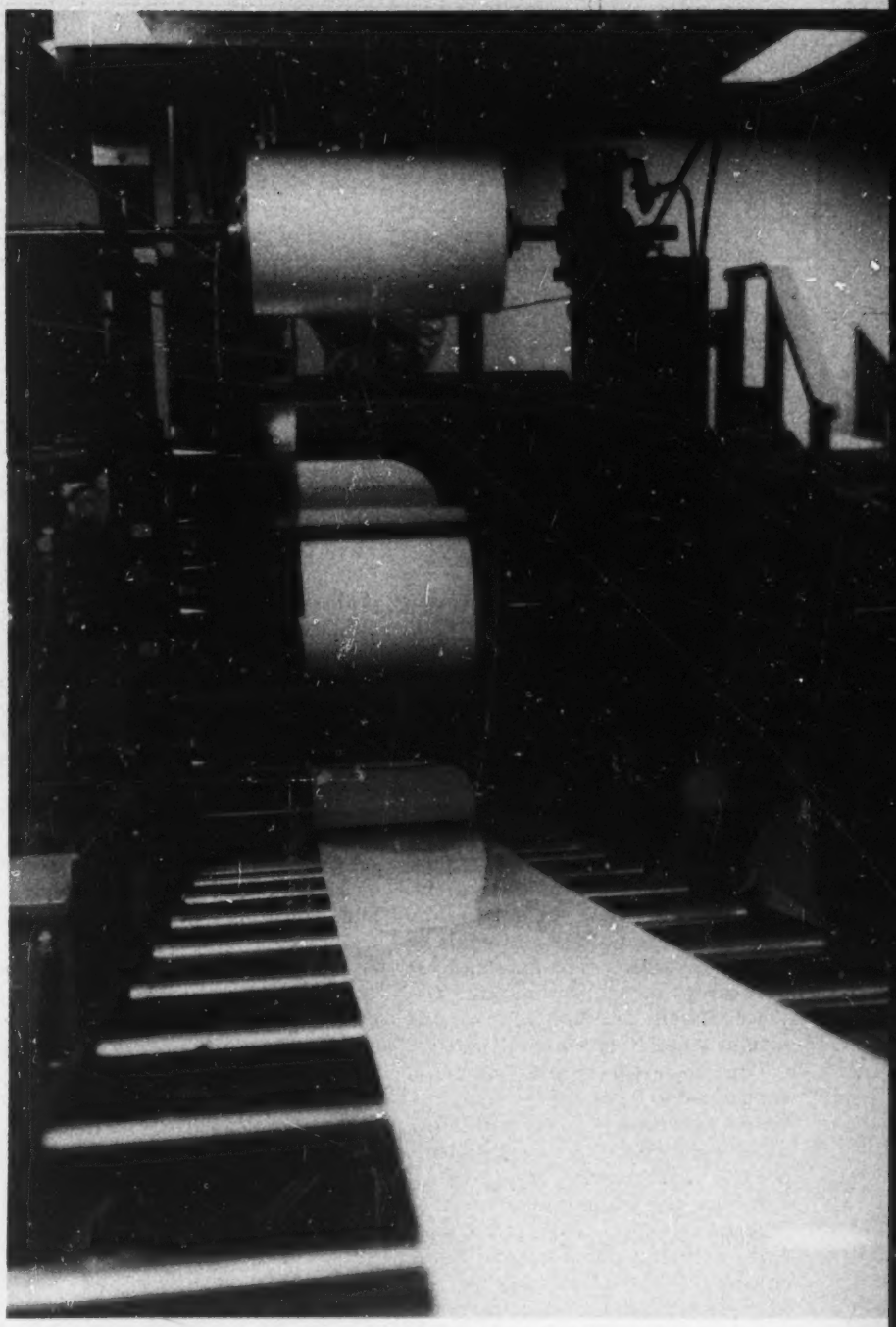
Ethylene products' costs are highest in U.S.



Source: DeWitt & Co.

Plastics Expand Into New Markets

Bruce F. Greek, C&EN Houston



Extrusion of Calibre polycarbonate resin at Dow Chemical's Freeport, Tex., plant

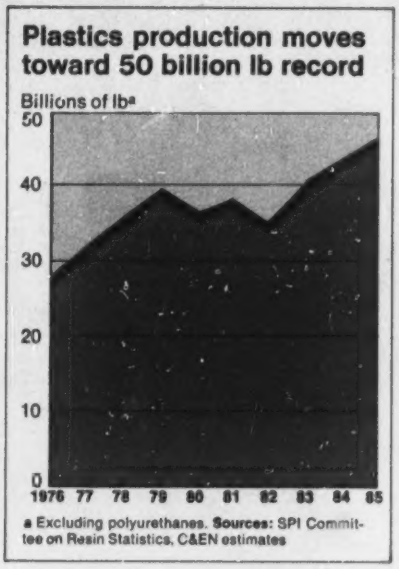
Plastics, in spite of the lingering hype from the 1960s, are characterized in some quarters as stodgy downstream chemical products. Indeed, the domination of the plastics industry by the large-volume commodity products does indicate a mature segment of the economy.

Looking beneath the commodity end of the business, however, a lot of development work is under way that's lending an air of excitement to plastics and changing some of their applications. Much of that work is allowing them to expand into markets that heretofore have been served only by more traditional products such as glass and metals.

Pushed by these and established uses, the plastics industry again will post new highs this year in all the usual statistics of production, consumption, and value of shipments. However, growth in these areas of performance could be somewhat lower than in 1984 when recovery from the most severe recession in 50 years was completed. Still it quells much talk about a maturing plastics industry.

Production in the U.S. of all kinds of plastics, excluding polyurethanes, likely will exceed 46 billion lb in 1985, up some 4% from 1984—and some marketers are forecasting a 7% jump.

U.S. consumption of plastics is expected to grow even faster. At the same time, exports are declining and imports are making new inroads. Exports of all kinds of plastics in the early 1980s exceeded 10% of production. Last year, under pressure from new plastics plants built in many developed and developing countries, exports slipped to about 9% of output. The volume of plastics imported into the U.S. also is expected to grow slightly, adding to the amount that will be consumed here.



The total value of plastics shipments, including exports, might go over $20 billion for the first time. Among chemical products, plastics rank third in value of shipments, exceeded only by industrial organic chemicals and drugs, according to Department of Commerce data. Among other commodities, at the 1985 forecast value for shipments, plastics will rank fourth in value of shipments after steel, paper and paperboard, and aluminum, and displace cement and concrete, which formerly had held fourth place.

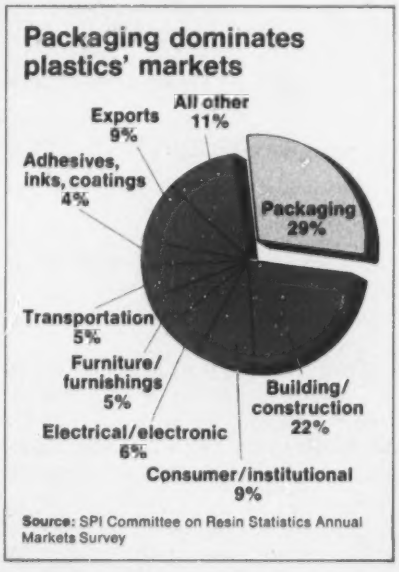
Growth of the various polymers considered to be plastics varies widely. Because their base is small, some new, small-volume, high-priced polymers are growing at high rates. However, the large-volume thermoplastic polymers—such as polyolefins, polystyrene, and polyvinyl chloride (PVC)—and most of the long-established thermoset polymers that together account for more than 80% of total plastics production will have growth rates in the single-digit range.

The plastics industry is huge, comprising all major-sized chemical companies, hundreds of small chemical companies, and many chemical subsidiaries of oil, steel, and diversified companies. Some of these companies produce the monomers that they subsequently polymerize to other products. Some also produce the various additives and other materials used in processing plastics either for themselves or for sale to others.

Among major plastics producers who are integrated back to monomers, some—mostly those who are a part of oil companies—are integrated further back to hydrocarbon raw materials. Among such polyolefin producers are Amoco Chemical, Exxon Chemical, Gulf Oil Chemicals, Mobil Chemical, Phillips Chemical, and Shell Chemical, that either produce ethylene and propylene or obtain these olefins from their parent oil companies. These companies account for about 40% of the ethylene capacity in the U.S. Their combined polyethylene capacity also accounts for about a third of the total of low-density and high-density polyethylene capacity.

Companies that polymerize monomers that are one chemical step beyond the basic olefins are more likely to buy olefins and other monomers, such as benzene and chlorine for styrene and vinyl chloride. Dow Chemical is an exception in that it makes vinyl chloride and sells this monomer but does not make polyvinyl chloride. Dow does make styrene and polystyrene, as well as other vinyl polymers.

The vinyl plastics are produced more often for captive consumption by companies that may buy monomers. Some of these companies make polymers for specific markets, such as Certain-Teed Products for flooring materials; Formosa Plastics, B. F. Goodrich Chemical, and Shintech for pipe and fittings; and Air Products & Chemicals, Du Pont, and Monsanto for coatings.



The thermoset plastics—phenolics, polyesters, epoxies, and urea/melamines—require more than one reaction step beyond the initial material. Many of these plastics involve several steps before a polymer of commercial interest is made. Thermosets producers offer both very specialized and commodity polymers.

Some of these producers have large captive uses for their production. For example, Georgia-Pacific, Masonite, and Owens-Corning Fiberglas make phenolic resins for adhesives and binders in building materials that they also make. Formica makes melamine resins for its line of surface coverings. Others, such as American Cyanamid, Borden Chemical, Chembond, Monsanto, and Reichhold Chemicals, make urea and melamine resins for adhesives of various kinds that they market or sell to others that formulate and sell adhesives.

Epoxy and polyester resins are a little different. Most epoxy resins made by such companies as Celanese, Ciba-Geigy, Dow, Reichhold, and Shell Chemical are sold to other companies that in effect fabricate the resins into end products, including coatings, adhesives, and specialties. In much the same way, many unsaturated polyester resins that are made, for example, by ICI Americas, Koppers, Silmar division of Sohio Chemical, and Union Carbide go to others for preparation of end products.

With producers making a wide range of both commodity plastics for many kinds of uses and specialty plastics for very specific uses, the end uses of plastics have grown to encompass all segments of consumer products. Without plastics, present life styles would revert to levels of 150 years ago. Many different plastics fit the same uses and some fit only a single use. The interpolymer competition continues to grow in most end uses, leading to constant development work on new polymers, blends, composites, and the like.

The major-volume plastics—the

Special grades characterize low-density polyethylene

Even after a few years of commercial availability, linear low-density polyethylene (LLDPE) keeps getting lots of attention, much of it generated by ongoing development work. At the same time, conventional low-density polyethylene keeps moving along with remaining plant capacities operating at high levels.

Capacity to make all forms of LDPE (densities of 0.94 or below) totals about 10 billion lb a year. That's a soft estimate, however, because of shifting between high-density and low-density product in plants that have been converted to make LLDPE or in new plants built specifically for LLDPE. About a quarter of the total of LDPE capacity can be operated to make LLDPE. Unreported conversions could later raise this fraction even higher. Some HDPE capacity also can be used to make LLDPE.

If production of all forms of LDPE reaches 8.6 billion lb this year, then the average plant operating rate will be about 85% of nameplate capacity. That volume would mean another good year for LDPE.

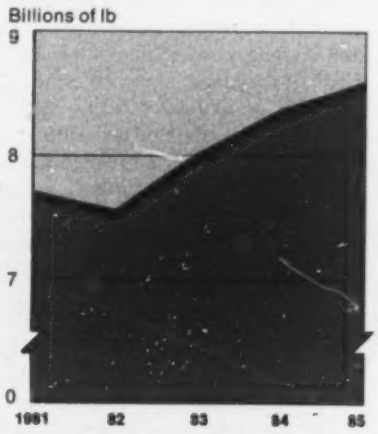
Another factor that could make this a strong year for polyethylene manufacture is the continuing pressure on ethylene prices, although to an integrated producer, this pressure isn't necessarily a good thing. But lower raw material costs could help to offset the pressure on polymer prices from consumers who follow the material cost situation closely.

High production, however, doesn't always make for high profitability, and in the past this caveat fitted the polyethylene business. To overcome the severe competition, producers have been coming up with ever more specialized grades of polyethylene to fit the special needs of fabricators. To a degree, these developments have helped production because initial demands for large-scale evaluations make some additional inventory necessary.

These many specialized grades, numbered in the hundreds by some in the industry, also add to producers' costs. Operators lose time by shifting between molecular weights or between different polymer properties. Some operators, however, claim that time lost is minimal because of the flexibility they have built into their plants. Nevertheless, additional testing and other costs, including additives for special purposes, do boost the total production cost. Producers may not be able to recoup the higher cost for very long by higher price because competition soon offers an identical or similar resin.

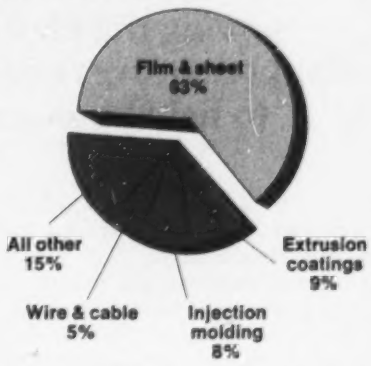
Specialty resins will continue to be brought to market. One example receiving evaluation by fabricators is the very-low-density polyethylene resins commercialized by Union Carbide last fall. Those resins have densities as low as 0.900 and are claimed to have unusual softness, making them competitors for some of the ethylene copolymer resins.

Production



Sources: SPI Committee on Resin Statistics, C&EN estimates

Consumption



Source: C&EN estimates

workhorses of the industry—are the polyolefins, polystyrenes and other styrenic polymers, polyvinyl chloride, epoxies, phenolics, and unsaturated polyesters. Among the many other classes of plastics, some, such as polyurethanes, are produced in very large volumes, and others, such as polycarbonates, in small amounts. Some of these plastics are grouped together because of the kinds of uses they have—for instance, engineering plastics.

Nylon resins are considered to be engineering resins, but because of their recent rapid growth, they have attained a category of their own. Production last year of nylon resins used for other than textile applications was nearly 400 million lb, up substantially from 321 million lb in 1983, according to the Society of the Plastics Industry's Committee on Resin Statistics. About two thirds of nylon plastics are used as injection-molded parts, such as gears and bushings for automotive, appliance, toy, photographic, and other applications. Other substantial uses include films, electronic parts, wire and cable coverings, and in large monofilaments used as fishing lines and in making rope.

Other engineering thermoplastic resins include the acetals, polycarbonates, polyphenylene sulfides, thermoplastic polyesters, polyphenylene oxides, polyimides, polyamide-imides, and fluoropolymers. Details of individual production for most of these plastics are not available.

Many of the major plastics companies make one or more of these thermoplastic engineering resins. This group of resins has moved up and down the production scale, depending on the economy and on application developments. In 1983, production of engineering resins topped 1979 production and then increased to about 800 million lb in 1984.

Because of the wide diversity in uses of these resins, classifying end uses is difficult. Electrical and electronic components account for about 35% of the estimated total. Transportation components take another 15%, with construction, consumer

High-density polyethylene capacity use is high

High plant operating rates continue to characterize high-density polyethylene (densities above 0.94) production. The introduction of linear low-density polyethylene at one time posed a threat to the rapidly growing demand for HDPE, but as yet, this threat hasn't become significant enough to reduce HDPE consumption.

Some slowing in production growth of HDPE is expected during 1985, just as a slower growth is forecast for almost all major-volume polymers. This forecast is based on an expected slower expansion in the general economy, which has become the controlling factor in plastics growth.

Production of HDPE nevetheless likely will reach 6.4 billion lb in 1985, and possibly higher, setting a new output record for this resin. Further gains in production may be limited by a lack of capacity. At the beginning of 1985, capacity, exclusive of that which could be shifted from making LLDPE, was estimated at 6.5 billion to 6.8 billion lb a year. An additional 2.5 billion to 3.5 billion lb of capacity or more is used to make LLDPE. A sizable fraction of that capacity could be switched easily to make HDPE.

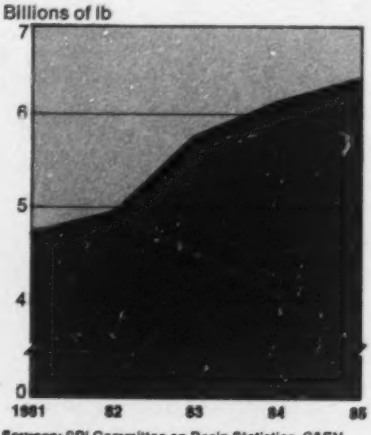
If production of HDPE reaches 6.4 billion lb this year, and if firm capacity is counted at 6.8 billion lb, then plants will be running at almost 95% of nameplate capacity—in effect, all out. Probably some additional production will come from plants converted to make LLDPE. And some small relief for domestic demand also could come from a decline in exports during 1985, perhaps adding 50 million to 100 million lb to the domestic supply.

Development of the blow-molded bottle markets through better resins and high-speed machines has been behind the relatively fast growth in demand for HDPE. As one result, the resin has taken nearly all of the 1-gal milk bottle market. A move toward the half-gallon-size market is slower than was the shift to the 1-gal size.

The slower move into other milk and juice container sizes had been thought to be a cause for a slowing in the demand for blow-molding resins. But in 1984, the shift toward HDPE for motor oil containers began, and that helped to drive demand in this use area again. The potential to replace metal/composite cans for motor oils likely will keep demand for HDPE growing for quite some time.

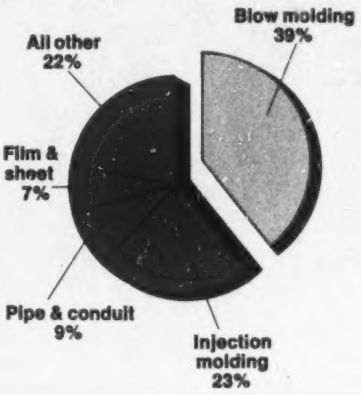
Other uses, such as injection molding of many kinds of fabricated items, also keep pushing demand for HDPE. Mold development continues to extend injection molding. Film, pipe, and conduit show good growth rates.

Production



Sources: SPI Committee on Resin Statistics, C&EN estimates

Consumption



Source: C&EN estimates

products, and industrial products each accounting for about 10%.

Many other thermoplastics, ranging from complex man-made polymers to modifications of natural products such as rosins, are produced in varying quantities. Production and sales data are available for some of these plastics. For example, production of various acrylic resins for uses other than making fibers totaled nearly 1.4 billion lb in 1983, the last year for which data are available from the International Trade Commission.

Other large-volume miscellaneous thermoplastic resins include the various petroleum hydrocarbon resins, production of which amounted to more than 250 million lb in 1983, according to ITC. Output of modified rosins, rosin esters, and modified rosin esters was close to 400 million lb in 1983. Production of nonnylon polyamide resins was much smaller, at about 60 million lb, as was that of polyterpene resins, at 35 million lb.

A large number of miscellaneous thermoset plastics also are produced. Smaller companies often make these materials for captive use in their products such as coatings and adhesives. The various alkyd resins dominate this group of thermosets. More than 80% of the 720 million lb of alkyd resins produced in 1983 were based on phthalic anhydride. Much smaller-volume plastics in this group of thermosets are the silicones, polybutadienes, and glyoxal-formaldehyde resins, among others.

Another important thermosetting plastic resin group is polyurethanes. No authoritative sources of production data for these plastics are available because of the wide diversity of producers. Polyurethane foams are relatively easy to make by combining an isocyanate and a polyol. These two components can be either batch mixed or metered out and put into some type of control for size and volume. Many times, additional materials such as blowing agents or cell formation controls are added. More-sophisticated production methods continue to be developed, but these haven't reduced the number of producers very much, as is the case for many of the makers of thermoplastics.

Most polyurethane foams are classified either as flexible or rigid. Of the close to 2 billion lb of polyurethane foams sold or captively con-

Polypropylene looks strong, but lags in profitability

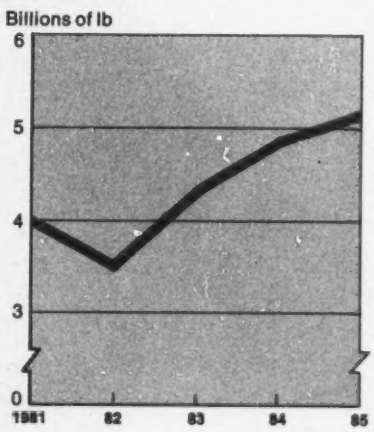
Polypropylene has all the characteristics of a profitable polymer. Consumption of the resin is up quite strongly over that of a year ago. Capacity currently is being utilized at nearly the effective limit. New developments in uses and fabrication techniques are announced frequently. And manufacturing technology continues to be improved in areas such as catalyst development.

But profitability isn't all that high, according to producers. Clearly, prices haven't advanced as they might have for a resin whose production plants now are running close to all out. Future expectations, as they thwart efforts to increase actual selling prices, might be a reason for low profitability. Inventory reduction also could be another reason. Propylene prices, although not controlled at all by demand for making polypropylene, could be hurting profitability by staying above ethylene prices and by reducing profit to producers who are trying to be competitive with polyethylene.

Even with a lack of profitability, production of polypropylene again will increase at an above-average rate for plastics in 1985; it likely will be up about 7% to 5.2 billion lb. This production will come from a nameplate capacity of about 5.6 billion lb for the year. Capacity will rise about 150 million lb during 1985, most of which, but not more than 100 million lb, will be coming from a plant with an announced nameplate capacity of 175 million lb built as a joint venture of Union Carbide and Shell Chemical in Seadrift, Tex., and using the Unipol technology and the Shell catalyst. This plant, after getting through the usual technical difficulties, is expected to produce for half of the year. The rest of the expected increase in capacity for this year will come from debottlenecking efforts, including the use of improved catalysts, by several of the other producers.

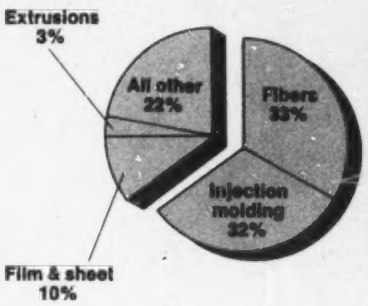
Using those forecast production and capacity figures, average operating rate for the year will be 93%—very close to the effective operating rate, especially if time is lost in making changes to different grades.

Production



Sources: SPI Committee on Resin Statistics, C&EN estimates

Consumption



Source: C&EN estimates

Two possible avenues could be used to avoid a polypropylene supply crunch from developing this year. One, according to an industry source, is the use of new catalysts and other plant improvements that could increase effective capacity 5% or so, much more than the usual 1 to 2% obtained in debottlenecking programs. The other way is to cut net exports of polypropylene. Total exports of the plastic were off slightly in 1984, a possible indication of a larger change due in 1985.

A decline in net exports of polypropylene would allow domestic markets to expand faster. These markets likely could take much more resin in such end uses as injection-molded items and fibers, the current large applications at about a third of total demand each. Some smaller applications such as blow-molding of containers are rising even faster, but from quite small bases.

sumed in the U.S. in 1984, flexible foams make up about two thirds, according to SPI's Committee on Resin Statistics. This production barely topped the previous high in production for various forms of polyurethane set in 1979. A few other forms of polyurethanes, such as elastomers and coatings, are made.

The economy quite strongly influences demand for polyurethanes because about 45% is consumed in the manufacture of furniture, bedding, and floor coverings with another 20% going into construction. Transportation equipment takes more than 15% of consumption. As might be expected, flexible polyurethane foams account for most of the uses in furniture and transportation. In construction, rigid polyurethanes are used mainly in commercial roofing and wall sheathing.

Polyurethanes account for about two thirds of the sales of plastic foams going to builtup and singleply membrane roofs, with polystyrene and phenolic foams taking the rest. The high heat insulation value of polyurethanes and their chemical kin, the polyisocyanurates, is helping move the board forms of these materials into the renovation business as well as into new construction.

The furniture markets for polyurethanes are growing at a slower pace, partly because of their size. Fashion in furniture, as well as the economy as it influences housing starts, partly affects demand. The outlook for this use of polyurethanes and for the much smaller carpet and carpet underlay use remains one of slow growth.

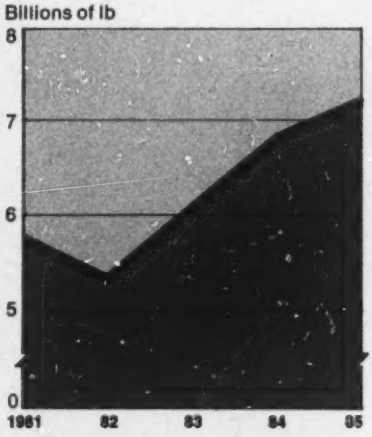
The forecast for slower growth in furniture uses of polyurethanes suggests a repeat of the early 1980s when these uses, as well as transportation uses, declined and held total demand down 10 to 15% for three years. Plants making the components for urethanes were shut down for varying periods. Then in 1983, a recovery brought demand back to prerecession levels. The current slowing may not be perma-

PVC use is growing well, but worries of slowdown persist

As polyvinyl chloride producers ponder whether monthly production has passed its peak for this year, they are wondering if a slowdown will occur during the second half of 1985 and how bad it might be if it does occur. A reasonably strong second half would give annual production a boost of 4 to 5% over 1984 to about 7.2 billion lb.

So far, demand has been showing the growth needed to attain that forecast. The gain, however, will be but a bit more than half of 1984 growth, a year in which prices dropped significantly during the second half.

Production



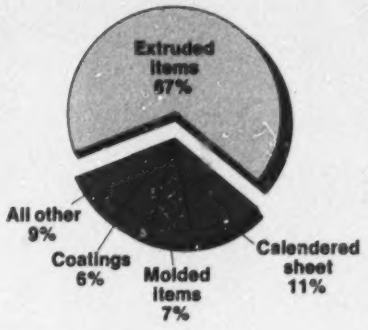
Sources: SPI Committee on Resin Statistics, C&EN estimates

If 1985 PVC production does total 7.2 billion lb, the plant nameplate capacity of about 8.5 billion lb will be operated at an average rate of 85%. That rate harkens back to the late 1970s when new records for production were set each year and when operating rates exceeded 90%. As is the case for other major-volume plastics, the operating rate for plants can only be guessed because of the small variables in capacity that often are not picked up for some time after they are put in place. Just as are units for making other resins, PVC plants are continuing to be streamlined by technical innovations and other debottlenecking efforts.

Along with plant operating rates, producers also are looking hard at pricing of PVC. After a good start in early 1984, prices plummeted in the fall because of inventory cutting. Again in early 1985, prices rose substantially from about 20 cents a lb to about 30 cents a lb, with considerable variation depending on grades and types. But recent efforts to increase prices have been less effective, partly because chlorine prices have leveled off after a series of increases. As with further gains in monthly production, additional price increases seem less likely during the second half of this year.

The PVC production and price increases derive from further recovery in building and construction, heavily weighted toward increases in housing

Consumption



Source: C&EN estimates

starts so far this year. The building/construction uses of PVC account for close to 60% of total consumption in the U.S. Most of these uses are extrusions of one kind or another, with pipe and conduit by far the largest. Other important and relatively faster-growing extrusion uses in building are siding and window frames. Home and commercial building also absorbs large shares of the calendered sheet made of PVC as floor coverings.

PVC production during the first half of the year has jumped because of the building of inventories of resins to be fabricated into the various components used in construction. Estimating the final demand for PVC in these uses continues to be difficult for the industry. Errors in making these estimates in 1984 led to the price debacle late in the year that made annual profits look anemic.

nent, especially if construction uses continue to increase as they did during the recession and as they are forecast to do this year.

This cycling of demand may be behind Dow's recent purchase of Upjohn's polyurethanes operations. Dow will get a 270 million lb-a-year methylene-diphenyl diisocyanate plant at La Porte, Tex., foams manufacturing facilities, an equipment manufacturing plant, and interests in various foreign polyurethane materials plants. These operations are expected to fit in with polyurethane materials businesses that Dow has had for some time.

Changes in ownership of plastics operations have been increasing in the 1980s. Another recent example is Shell's selling its polystyrene business to Huntsman Chemical. These changes, according to some industry sources, come about partly because of changes in the end-use patterns for plastics. Not only do the uses of individual polymers change, but the uses of plastics in general.

The total volume of plastics consumption has risen to such a large extent that some of these changes in the end-use pattern are obscured by the industry's size. Among the nine major use categories, two have declined significantly in their share of the total market. They are exports and adhesives, inks, and coatings. These declines largely have been made up by bigger shares going to packaging and construction. Somewhat unexpectedly, the share of plastics in electrical/electronic applications has declined slightly during the past five years.

Packaging at more than 29% of the market for plastics continually adds to both the volume and fraction of use. That puts a whopping 13.5 billion lb or more of plastics into a variety of packaging uses during 1985. More than 99% of that volume will be thermoplastics, with low-density polyethylene accounting for the largest single share, at 40% or more. In recent years, low-density polyethylene has been losing part of its packaging market, mostly at the expense of its high-density relative, which now accounts for about 26% of the packag-

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Polystyrene output expected to set new record

This year polystyrene could fulfill the optimistic expectations of many. Production likely will top the record high of slightly more than 4 billion lb of both straight and rubber-modified polystyrenes. Profits for producers could improve as large increases in benzene raw material costs are passed on and as new grades and types of the polymer with higher prices are introduced.

Following a big drop in 1982, production of polystyrene has been rising steadily. A combination of factors has caused this upswing: the large improvement in the general economy, better export sales (although these may be changing), and new polymers with improved processing characteristics.

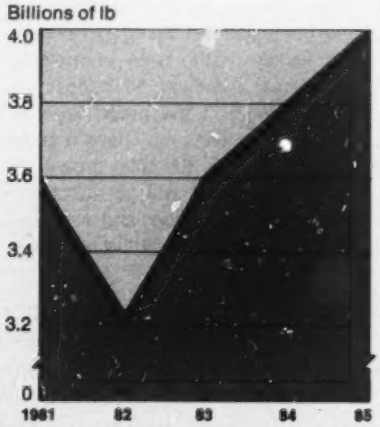
If production of polystyrene increases to about 4 billion lb this year, plant capacity, estimated at 5.5 billion lb at the beginning of the year, will run at an average rate of just 73%. This relatively low plant utilization, when compared to rates for other major-volume plastics, will keep this segment of the plastics business very competitive. However, the operating rate could be the best of the 1980s so far by a slight margin, even with about 150 million lb of capacity being added during 1984 through various debottlenecking programs.

Actual operating capacity differs considerably from the nameplate total. A large portion of capacity was shut down during the 1982 recession, and although not yet scrapped, some may never run again. Therefore, the operating rate for plants now running is well above the estimate for the fraction of existing nameplate capacity being used.

To achieve a production growth of 5% in 1985, much of the development work on polystyrenes during the past few years will have to bear fruit. More market share from other polymers and from other materials will have to be captured in its major end-use areas, such as packaging, and in many smaller but higher-performance requirement products such as cabinets and housings for electronic equipment.

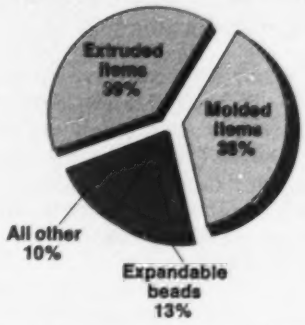
As is happening with other polymers, the grades and types of polystyrene are being expanded rapidly as producers tailor their lines to capture demand. Packaging, at well over 40% of polystyrene consumption, gets much attention. Emphasis is on improved processability to allow molders and extruders to increase throughput rates, and on polymers to permit making even lighter containers and to reduce finishing operations. Some of these same desired properties could allow additional capture of packaging markets still served by glass, metals, and paper.

Production



Sources: SPI Committee on Resin Statistics, C&EN estimates

Consumption



Source: C&EN estimates

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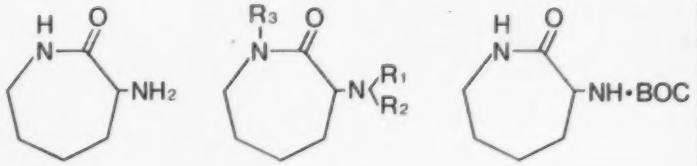

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Phenolic resins—economy is key to fortunes

Phenolic resin production may stall in 1985, increasing just marginally, if at all, over production of last year. Pricing, and therefore profitability, will be sluggish at best. No additional producers are expected to join the business. Nor are any large producers expected to drop out this year.

The performance of phenolic resins, a mature business, reflects the economy's effect on its major end uses—construction. More than 60% of consumption is as adhesives for products such as plywood, particle board, and insulation binders. Last year, this big industry again slowed, causing production of phenolic resins as reported on a gross weight basis actually to decline, but less than 1% to about 2.5 billion lb, according to SPI's Committee on Resin Statistics. Some recovery is under way in construction, but some forecasters question whether the upturn will continue throughout all of 1985.

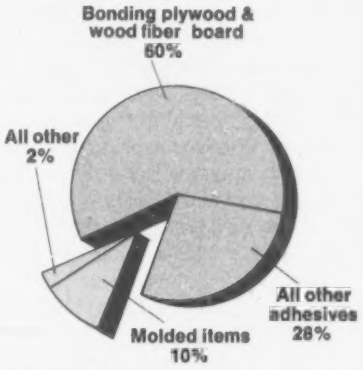
No estimate of the U.S. capacity to make phenolic resins can be made because of the wide variations in size of plants, the blocked operations in which other resins are made in the same reactors used to make phenolics, and the wide diversity of resins that can be considered phenolics. For the same reasons that capacity for this segment of the plastics industry can't be estimated, an estimate of plant operating rate is unimportant. Small producers who can switch from one resin to another and who make phenol resins for captive uses have little concern about the rate at which their units operate but are concerned about selling the products made using the resins.

Most of the larger-volume producers of phenolic resins, however, operate on a generally continuous basis. These producers either sell or require the resins for use in making construction materials and operate to meet sales demands, which are quite seasonal. Inventories of construction products are of considerable concern to these large producers. Changes in building materials inventories affect production rates, so phenolic resins producers try to regulate their production by making other bonding and adhesive resins as well as molding and other types of resins.

On a gross weight basis, phenolic resins made for use in bonding plywood account for more than half of sales and captive use. Resins used in bonding fiber board and insulating materials take about another 20% of total sales and captive uses. If other smaller construction industry applications are included, about three quarters of phenolic resins production goes into this single industry. As a result, many phenolic resins producers have close ties to construction or are primarily producers of building materials. The fortunes of these materials, as they develop from home and commercial construction, therefore determine how the demand for phenolic resins grows.

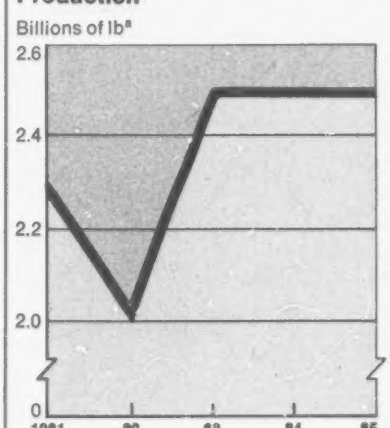
Many small uses of phenolic resins have been and are being developed, most widely in the area of molding compounds. Although an occasional phenolic resin in the broad area of miscellaneous uses may have a large fractional growth, the total growth of phenolics probably will be about the same as that for plywood and, similarly, will depend on how well the economy performs.

Consumption



Source: C&EN estimates

Production



[a] Gross weight **Sources:** SPI Committee on Resin Statistics, C&EN estimates

ing market. Much of the remainder of thermoplastics in packaging uses goes to polystyrene at more than 12%, polypropylene at nearly 8%, and PVC and thermoplastic polyester at about 5% each.

Various kinds of flexible packaging, mainly bags, take nearly half of the volume in packaging. Bottles and the like take another 20%. Food containers, including disposable cups, have been slipping in their share of packaging and now are down to about 12% of the total.

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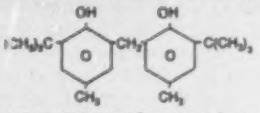
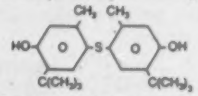
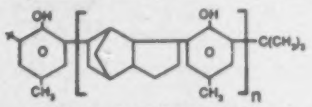


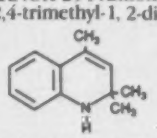
ULTRANOX 236 Antioxidant
4,4'-thio-bis(2-t-butyl-5-methylphenol)



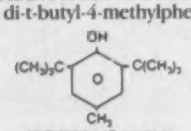
ULTRANOX 256 Antioxidant
Polymeric sterically hindered phenol



ULTRANOX 254 Antioxidant
Polymeric 2,2,4-trimethyl-1, 2-dihydroquinoline



ULTRANOX 226 Antioxidant
2,6 di-t-butyl-4-methylphenol



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CIRCLE 7 ON READER SERVICE CARD

Epoxy still a question mark for 1985

Epoxy resins output rose more than 20% during 1984, a year of substantial economic growth. The major end uses of epoxy resins—coatings and laminates—tacked on the largest gains. Although production slowed some early this year, the considerable seasonality in epoxy resin output makes it too early to call as yet.

Epoxy resin production last year reached 406 million lb, exceeding 1983 production by 72 million lb, and topping the previous record for production of 361 million lb set in 1979. But output also dropped to 286 million lb in 1982 during the recent recession. The relatively wide swings in production characterize this segment of the plastics business as one strongly influenced by the level of industrial production. Most epoxy resins eventually end up in products whose demands rise and fall with the economy—beverage cans, automobiles, and electronic devices, for instance.

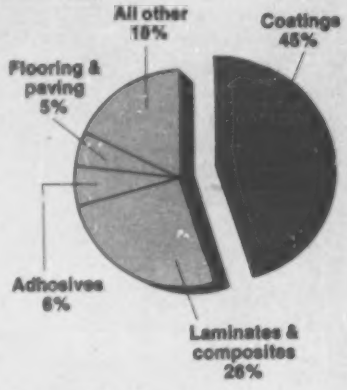
Production of 406 million lb last year certainly helped capacity utilization, but did not seriously strain capacity. During 1984, Ciba-Geigy brought on stream some net additional capacity, bringing the total for liquid and solid unmodified resins to about 520 million lb. The average capacity available for utilization last year was more than 450 million lb, making the operating rate close to 90% of nameplate.

With capacity running at rates higher than 90%, some price increases for epoxy resins were announced in late summer. The increases were not large and prices fell back. If the seasonal upturn in demand continues, then price increases may be tried again soon.

In 1984, about 45% of U.S. consumption of epoxy resins went into various kinds of protective coatings. About half of epoxy coatings were used as automotive finishes and as beverage can coatings. Neither of these uses is expected to grow very fast and both may be subject to downturns in the economy.

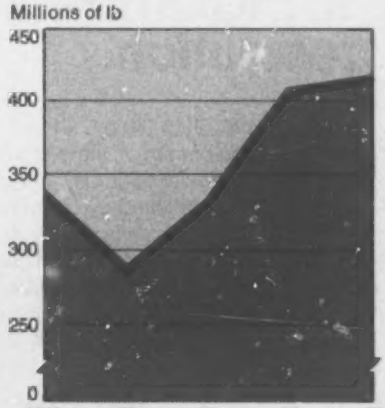
Nearly 20% of epoxy resins demand went to fiber-reinforced laminates used in making printed circuit boards. Epoxy resins are expected to remain the material of preference for these boards, but increasing performance demands could cause board producers to shift to other polymers later in the 1980s.

Consumption



Source: C&EN estimates

Production



Sources: SPI Committee on Resin Statistics, C&EN estimates

Another big market for plastics, building and construction uses (about 22%), closely follows the economy. These uses turned down during the early 1980s when home building fell off drastically. Roughly half of plastics consumption in these uses is in materials for structures and more than 35% more are used in pipe, conduit, and fittings.

As might be expected from the size of pipe demand, PVC accounts for about 40% of the resins used in construction. Phenolics, because of

their extensive use as adhesives and bonding agents, hold second place at 23%. Urea/melamine resins are third at 10%. Thermosets hold about 40% of the building/construction uses, in contrast to their use being minuscule in packaging.

The construction recovery last year boosted plastics used in pipe, conduit, and fittings to a new high of 2.85 billion lb, 4% more than the previous record in 1979, according to SPI's thermoplastics pipe and fittings report. PVC accounted for about 85% of shipments of plastic pipe, conduit, and fittings. Some 42% of plastic pipe was used to carry fluids under pressure. Another 28% was for sewer and other drainage piping. About 15% was for drain, waste, and vent piping in individual buildings. And 13% was used as conduit.

Although acrylonitrile-butadiene-styrene (ABS) resins accounted for only 5% of pipe shipments, they comprised more than 13% of the resins used in fittings. Even so, the share of the fittings market going to ABS continues to decline as does ABS use in the pipe market.

Until recently, consumer and institutional uses of plastics had been on hold. These applications have begun to grow again as product development gains new uses. Long-term uses such as in table and kitchen wares and in toys and sporting goods have been either not growing or have been declining.

Thermoplastics comprise 95% of the plastics going to consumer/institution uses, with polystyrene, at more than 20% of the total, being the largest-volume of these. Polypropylene accounts for 15% of this total, with both HDPE and LDPE just behind.

The electrical/electronic uses of plastics have been trending downward, partly because of downscaling in the size of this kind of equipment. Appliance uses of plastics have been hovering near 800 million lb for the past five years, but use in communications equipment has been declining. The miscellaneous, small-volume, high-priced thermoplastics and thermosets have the largest share of resins made into electrical/electronic items. This share, at 26% of the total, indicates

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CIRCLE 26 ON READER SERVICE CARD

Bioregulators for Pest Control

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Paul A. Hedin, Editor
U.S. Department of Agriculture

Looks at new concepts and trends in pesticide chemistry and outlines approaches to the control of plants, insects, and diseases. Highlights the mechanisms of herbicides, fungicides, and endogenous plant hormones. Covers advances in bioregulators, both natural and synthetic. Will add much to the elucidation and adoption of novel chemical compounds for the control of pests.

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the performance demands of these industries' products. PVC, LDPE, and polystyrene at 12 to 15% each are other important resins in these applications.

Both transportation and furniture/furnishings uses of plastics have been growing very little over the past five years. These outlets each take about 5% of total plastics consumption, but with variations as car and house sales rise and fall. Components for motor vehicles take about 85% of plastics used in the transportation category, with boats and recreational vehicles accounting for most of the rest. Unsaturated polyester and phenolic resins make up most of the 27% share of this market captured by thermoset plastics. Polypropylene, because of its fabrication to fibers, receives about half of the consumption of plastics in the furniture/furnishings market.

Adhesives, inks, and coatings made from plastics have declined in their share of the market, now to about 4% of the total. The decline in volume can be attributed in part to improvements that require less polymer to be used. Thermoplastics take about 70% of these markets.

In considering all these categories of plastics markets, many minor-volume, but very important, uses are obscured, and their novelty is hidden. For example, medical uses are growing rapidly from a small base, often are very specialized, and in many cases require much special processing.

Among these small hidden uses—some larger than the high-purity polymers for the medical field—are the emerging new uses for plastics. Such new uses often were developed for very specialized reasons and further development led to other uses that have ballooned in their demand for a plastic. One example often cited is the growth of polyester resins now widely used in making bottles for soft drinks, food, and other products. Polyester may go into bottles for many other products as more development work bears fruit.

Development of plastics to fit untapped end-use markets is leading to more complexities in the makeup of plastics. Terms borrowed from other industries, but new to the plastics industry, are appearing much more frequently—for example, alloys, blends, and composites. These terms define forms of plastics aimed at meeting demand for specific uses that previously couldn't be handled by plastics. Examples are many, including structural parts of highly stressed products such as aircraft, lightweight bicycles, highly heat-resistant plastics that have costs low enough to permit use in baking or other cooking utensils for the home, or in bottles that minimize transmission of oxygen and light as glass does now.

Making these new forms of plastics usually proves to be difficult. Often special plants or processing units have been built to make them. Several of the major producers of

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CIRCLE 36 ON READER SERVICE CARD

Polyester production growth slated to slow

Production growth of unsaturated polyester resins will taper off this year after two good years of recovery from the recession-caused decline of some 13% in 1982. If the economy remains healthy for the rest of 1985, production of these resins is expected to be up 2 to 5%. But if the economy slips, production surely will fall as it has in the past when disposable incomes declined and sales of luxury goods such as boats and other recreational vehicles fell precipitously.

Production of unsaturated polyester resins managed to set a record last year at 1.23 billion lb, up almost 15% from 1983 and slightly more than the previous high of 1.21 billion lb in 1978.

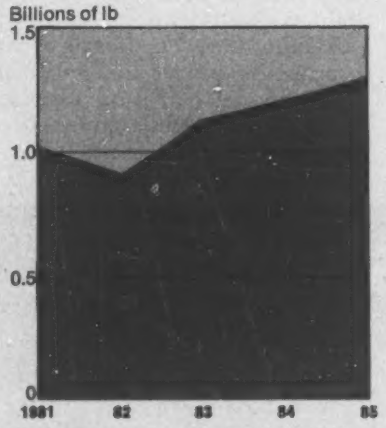
If forecasts for this year hold, output of unsaturated polyester resins again would set a record at 1.25 billion to 1.30 billion lb. That level of production would not strain capacity, which has been holding at about 1.6 billion lb. Nonetheless, capacity remains elusive because of the large number of dual-purpose reactors used by the industry to make these resins. The same reactors can be used to make other kinds of resins depending on the current demand on a producer. As is the case for other kinds of thermoset plastics, some of the production facilities may be left shut down for long periods during a year. Producers can do this because it is easy for them to start up reactors and because the capital investment required for reactors and auxiliary equipment is low.

Most unsaturated polyester resins—more than 75%—are fabricated with a reinforcing material, usually glass fiber, to offset their brittleness. Demand for these reinforced plastics, including the weight of the fibers and fillers, is forecast to grow about 5% during 1985.

About 40% of the reinforced applications, on the basis of the polyester resin alone, are in the construction area. Construction uses split roughly three ways: in corrosion-resistant tanks, pipe, and fittings; in bathroom fixtures; and in miscellaneous construction items. Transportation equipment ranks nearly as large on the basis of resin consumption. About two thirds of the transportation uses are boats and marine accessories. The other third is in automotive components. The remainder of reinforced polyester applications range widely from appliance parts to toys.

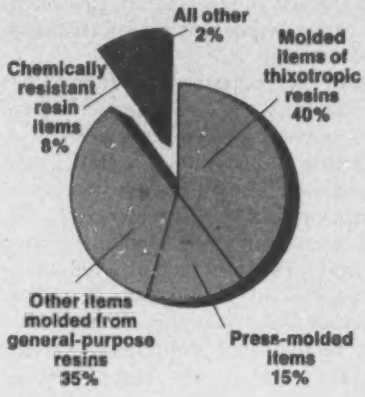
Nonreinforced polyester resins go largely to make cast items such as synthetic marble used as vanity tops in homes. The other big use is in auto body putty. Numerous small miscellaneous uses are coatings, adhesives, and bonding agents. None of these uses of polyester resins in the nonreinforced area are expected to grow very rapidly this year.

Production



Sources: SPI Committee on Resin Statistics, C&EN estimates

Consumption


All other 2%
Molded items of thixotropic resins 40%
Chemically resistant resin items 8%
Other items molded from general-purpose resins 35%
Press-molded items 15%

Source: C&EN estimates

plastics, such as Celanese, Dow, Du Pont, and General Electric, have completed facilities within the past year to make special alloys of plastics.

This segment of the plastics industry is fast-growing, probably more than 15% annually. According to Business Communications Co., a market research firm in Stamford, Conn., 1983 production of alloys and blends of plastics was about 300 million lb, worth more than $400 million. Other marketers have estimated 1984 production in excess of 350 million lb with a value of more than $450 million.

The basic resins that are involved in new alloys and blends cover most of the large-volume plastics, such as the polyolefins, polystyrene, and polyesters, but also include the smaller-volume polymers, such as specialty nylons, epoxies, and phenolics. Frequently, a reaction is involved in making an alloy; sometimes a copolymer results from grafting reactions.

As the plastics industry evolves, with its broad potential variety of alloys, blends, and other new forms made for special uses, it will become increasingly difficult to estimate output and use of plastics and monomers. Even now, many estimates of the production of plastic resins include weight of comonomers used with the basic monomer. For example, linear low-density polyethylene production estimates include the weight of the other olefins polymerized with ethylene, thereby overstating ethylene consumption slightly.

In time, after process developmental work, some specialty or engineering plastics likely will become commodity plastics. The result will be substitution of plastics in markets already held by plastics and further penetration in markets held by metals, glass, paper, and other materials. The slowing in fractional growth of the large-volume commodity plastics may be offset by higher growth of the specialty plastics. With the number of specialty plastics and variations of commodity plastics increasing so rapidly, the total growth of the plastics industry will remain well above that of the general economy—even if it's not so rapid as it was 20 years ago. □